AMENDMENTS TO THE SPECIFICATION

(1) On page 1, in the Title, please replace the title with the following amended title:

SAFETY APPARATUS AGAINST AUTOMOBILE ~~CLASH~~CRASH

(2) On page 1, please replace the paragraph beginning "The present invention" with the following amended paragraph:

The present invention relates to a safety apparatus ~~against~~ for an automobile ~~clash~~crash, wherein ~~A head~~ a head of a driver or passenger is recognized, thereby controlling a safety unit, e.g., controlling an unfolding of an air bag.

(3) On page 1, please replace the paragraph beginning "Further, it is not" with the following amended paragraph:

Further, it is not also easy to identify the head on the basis of shape patterns such as eyes, nose, ears. This is because glasses and ~~mask~~ masks disturb the head identification and the image processing becomes complicated, when the face ~~directs~~ is obliquely directed toward the area image sensor, thereby greatly changing the details of the face shape patterns.

(4) On page 2, please replace the paragraph beginning "An object of" with the following amended paragraph:

An object of the present invention is to identify a driver or passenger in order to control an air bag unfolding at a car ~~clash~~crash.

(5) On page 2, please replace the paragraph beginning "The safety apparatus" with the following amended paragraph:

The safety apparatus ~~against~~ for automobile ~~clash~~ crash comprises: at least one area image sensor for picking up an image of a passenger (possibly including a driver); passenger information extracting means for extracting a passenger information, e.g., adult or child; and a safety unit control means for controlling an operation of a safety unit ~~against~~ for an automobile ~~clash~~ crash (e.g., an air bag).

(6) On page 2, please replace the paragraph beginning "The passenger's head" with the following amended paragraph:

The passenger's head is extracted on the basis of the outlines of the passenger's head. The head outline shape is in general nearly an ellipse. Further, the head is rotated around the ellipse's major axis which is held almost along the vertical axis. Therefore, the head outline shape is changed little by an individual difference and head direction. Accordingly, a memory load for reference images is low and a load for image processing for extracting the head ellipse is also low, thereby reducing an image processing time period and improving an accuracy of the passenger determination. The safety apparatus ~~against~~ for automobile ~~clash~~ crash of the present invention is superior in a point of view of a rapid control of such a safety unit as an air bag, because the passenger recognition is more rapidly and accurately completed than conventional determinations by such other facial shapes as eyes, nose and mouth. Further, the present invention is more advantageous than the conventional passenger recognition, because glasses and a mask hide less part of the head, compared with the eyes, nose, or mouth, thereby degrading little the determination accuracy.

(7) On page 3, please replace the paragraph beginning "In the present invention,"

with the following amended paragraph:

In the present invention, the passenger's information is determined on the basis of a closed ~~curve~~ curve, a part of which is an ellipse.

(8) On page 3, please replace the paragraph beginning "FIG. 1" with the following

amended paragraph:

FIG. 1 is a conceptual block diagram of the safety apparatus ~~against~~ for an automobile ~~clash~~ crash of the present invention.

(9) On page 3, following the paragraph beginning "In the present invention," please

insert the following new paragraph:

One or more embodiments can provide that when any image was not detected within the region, a whole of a two dimensional image is processed at a next time. Also, in accordance with one or more embodiments, when any image was not detected within the region, a whole of a two dimensional image area is further continuously processed. Furthermore, in accordance with one or more embodiments, a shape and position of the head ellipse expressed by parameters are employed for selecting one of the reference images almost the same as that of the passenger.

(10) On page 4, please replace the paragraph beginning "FIG. 2" with the following

amended paragraph:

FIG. 2 is a flow chart for deciding a kind of a ~~passenger~~ occupant (including a ~~driver, assistant~~ driver and ~~other~~ passenger(s)), e.g., adult or child, thereby controlling an unfolding of an air bag of the safety apparatus ~~against~~ for an automobile ~~clash~~ crash as shown in FIG. 1.

(11) On page 4, please replace the paragraph beginning "FIG. 3" with the following amended paragraph:

FIG. 3 shows a future processing region (including a detected head ellipse) designated for detecting the head ellipse at a next time to come, thereby simply and rapidly detecting the present passenger, even when the present passenger has ~~once~~ moved outside the future processing region.

(12) On page 4, please replace the paragraph beginning "FIG. 1" with the following amended paragraph:

FIG. 1 is a conceptual block diagram of the safety apparatus ~~against~~ for a car ~~clash~~ crash of the present invention, wherein imaging means 1 (such as an area image sensor, e.g., CCD) is fixed at an upper lateral side of ~~a~~ an automobile body 2 in order to pick up an image of ~~an assistance driver~~ a passenger (including a driver) on ~~an assistance driver's~~ a passenger seat 3. Concretely, the area image sensor 1 looks down the upper space of a seat 3 and outputs the picked-up image to an image processing unit 5. The image signal is a sequentially outputted raster scan signal which constructs a two dimensional frame signal. The safety apparatus further comprises: an A/D converter 4 for converting the output from the area image sensor 1; and an air bag control unit 6 connected with the output terminal of the image processing unit.

(13) On page 5, please replace the paragraph beginning "The image processing unit" with the following amended paragraph:

The image processing unit 5: receives ~~a the~~ an A/D converted frame signal; stores it in a frame memory in order to reduce its noises, to emphasize outlines in it and to digitize the signal by two bits; and ~~processing~~ processes it for a decision of passenger kind, e.g., adult or child, male or female. In place of using the A/C converter 4, the output from the area image sensor 1 may be digitized at two bits and inputted into the image processing unit 5. Further, the output from the area image sensor 1 may be emphasized on the horizontal and vertical outlines and inputted into the image processing unit 5. Further, the area sensor 1 itself may outputs two bit digital signals.

(14) On page 6, please replace the paragraph beginning "Further, a part of or all" with the following amended paragraph:

Further, a part of or all of the image processing unit 5 may be constructed by a single hardware. Further, not two bit signals, but multi-bit signals, e.g., eight bit signals may be inputted into the image processing unit 5 in order to improve a quality and accuracy of the image ~~processing~~ .processing.

(15) On page 6, please replace the paragraph beginning "First, a boundary between" with the following amended paragraph:

First, a boundary between two regions different in brightness ~~in the two-dimensional image space~~is extracted at step S100 from a predetermined image region placed in a two-dimensional image space (that is, a scan region 32, illustrated in Fig. 3) for the sensor 1. The boundary in general includes a plurality of closed loop or outlines.

(16) On page 8, please replace the paragraph beginning "Next, the image region" with the following amended paragraph:

Next, ~~the~~ an image region surrounding the detected head ellipse is decided ~~at S114 to be~~as a future process region to be processed ~~at a time to come~~ by steps S100 to S110 in the next head image processing. The size of the future process region is set up in such a manner that the passenger's head ~~at the time to come~~ will ~~possibly~~ be ~~allowed~~ placed within the ~~set up~~ future processing region in the next head image processing, even ~~if~~ though the ~~present passenger once exited outside the set up future~~head is moved at a predetermined speed during the period of time from the current head image processing to the next head image processing ~~region~~. FIG. 3 shows the future processing region 30 (in the two dimensional scan region 32). The detected head ellipse 31 is surrounded by the future processing region 30.

(17) On page 8, please replace the paragraph beginning "Next, The" with the following amended paragraph:

Next, ~~The~~ the detected head ellipse is newly registered as a reference head ellipse at S116, thereby comparing at a first priority the newly registered reference head ellipse with a passenger's head ~~at a future recognition~~in the next head image processing. Thus, the ~~future processing time~~ period of time required for the next head image processing is effectively reduced. Here, even though the detected head ellipse ~~may be~~ is inclined with respect to a passenger's head, or is turned, the detected head ellipse may be registered~~rotated for the new registration~~.

(18) On page 8, please replace the paragraph beginning "According to the above" with the following amended paragraph:

According to the above explained safety apparatus, ~~the head image processing can be executed rapidly, without lowering a determination accuracy, because the passenger kind is determined by a head ellipse whereby a viewing angle is relevant little, an individual difference is small and therefore, an analysis is easy~~even though a viewing angle to a passenger's head is changed, a change of a detected head ellipse is small. Further, differences in head ellipses among passengers are small. Therefore, the head image processing can be easily executed for a detected head ellipse. Accordingly, the head image processing can be simplified and executed rapidly while suppressing the lowering of accuracy in the determination of a head image.

(19) On page 8, please replace the paragraph beginning "Boundaries without a passenger" with the following amended paragraph:

Boundaries without a passenger are extracted from a frame image and are stored beforehand. Then, the stored boundaries are subtracted from boundaries extracted at step s100 from a frame image with a passenger, and extraction of a head ellipse is executed at step~~executes~~ S102 ~~for extracting an ellipse~~based on the subtracted boundaries. Thus, the image noise is effectively removed.

(20) On page 9, please replace the paragraph beginning "Deformed head outlines" with the following amended paragraph:

Deformed head outlines with hat, cap or special hair style are registered for the reference head ellipses. ~~Thus~~In this case, even though a head ellipse is detected from a passenger with a hat, cap, or special hair style, the detected head ellipse can be appropriately compared with reference ellipses stored beforehand. Accordingly, the determination accuracy is improved. Further, lower head portions irrelevant to the hat, cap or special hair style may be employed as the reference head ellipses. In this case, when head image processing is executed for a passenger with a hat, cap or special hair style, a head ellipse is detected from a lower head portion of the passenger, and the detected head ellipse is compared with reference ellipses stored beforehand. Accordingly, even though head image processing is executed for a passenger with the hat, cap or special hair style, the degradation of the determination accuracy can be prevented.

(21) On page 9, please replace the paragraph beginning "The reference head ellipses" with the following amended paragraph:

~~The reference head ellipses are learned by inputting model images into the area image sensor 1.~~ A model image is registered in place of reference ellipses, and a learning operation using the model image is performed. That is, each time a head ellipse of a passenger similar to the model image is found, the head ellipse is registered as a reference ellipse. When the learning operation is continued, many reference ellipses are stored. ~~The learning results~~These reference ellipses may be stored in ROM. Therefore, the determination accuracy for a head ellipse of a passenger can be improved.

(22) On page 9, please replace the paragraph beginning "FIG. 4 " with the following amended paragraph:

FIG. 4 is a plan view of the ~~passenger's (driver's, or assistant driver's)~~ passenger seat 3, around which another area image sensor 11 as well as the area image sensor 1 are disposed distant by a prescribed distance along the front-rear direction, thereby measuring the actual distance between the passenger's head 50 and sensors 1 and 11 by using the stereo range finding method. The area sensors 1 and 11 are used both for the passenger determination and distance measurement.

(23) On page 11, please replace the paragraph beginning "The determination accuracy" with the following amended paragraph:

The determination accuracy is not lowered, even when the passenger rotates his or her head, because the area ~~sensor 1 n~~sensors 1 and 11 independently ~~determines~~ determine the passenger kind.

(24) On page 11, please replace the paragraph beginning "FIG. 6 shows" with the following amended paragraph:

FIG. 6 shows still another sensor arrangement, wherein the area image sensor 1 is disposed at a lateral side of the passenger's seat, while another area image sensor 11 is disposed ~~at a rear~~in front of the seat 3. The image size of the area sensor 11 is corrected on the basis of the position along the front-rear direction obtained by the area image sensor 1, while the image size of the area sensor 1 is corrected on the basis of the position along the right-left direction obtained by the area image sensor 11. Thus, the determination accuracy is further improved.

(25) On page 11, please replace the paragraph beginning "The determination accuracy" with the following amended paragraph:

The determination accuracy is not lowered, even when the passenger rotates his or her head, because the area sensor 1 and 11 independently ~~determines~~ determine the passenger kind. The shoulder width of the passenger is further measured by the area image sensor 11, thereby knowing more accurately the passenger's physical conditions.

(26) On page 12, please replace the paragraph beginning "If there is not found" with the following amended paragraph:

~~If~~ As illustrated in FIG. 7, if there is not found any head ellipse at step S100, boundary extraction, ellipse extraction and decision of head ellipse are ~~is~~ further continuously executed, in the same manner as those at steps S100, S102 and S104 illustrated in FIG. 2, all over the two dimensional scan region 32 at S118 ~~as shown in FIG. 7 (S100-S104 as shown in FIG. 2)~~. At step S120, the unit 5 judges whether or not a head ellipse is found at step S118. If a head ellipse is detected, then, S110 as shown in FIG. 2 is executed for finding a head ellipse candidate. On the contrary, if any head ellipse is not detected at S118, then, S108 follows for outputting a fact that no passenger is seated. ~~I~~It may be scheduled to search all over the two dimensional scan region 32 at a time to come, if any head ellipse is not detected in the future processing region 30.

(27) On page 12, please replace the paragraph beginning "Thus, the head ellipse" with the following amended paragraph:

Thus, ~~the~~ even though no head ellipse ~~can be~~is detected~~, even when it does not exist within the future~~ in the predetermined processing region or the future processing region in the previous head image processing, the detection of a head ellipse is executed all over the two dimensional scan region 32 at step S108 in the next head image processing. Therefore, a head ellipse of a passenger, of which a head is not placed in the predetermined or future processing region but is placed in the two dimensional scan region 32, can be detected.

(28) On page 12, please replace the paragraph beginning "FIG. 8 is another" with the following amended paragraph:

FIG. 8 is another conceptual block diagram of the safety apparatus ~~against~~ for automobile ~~clash~~ crash of the present invention. In place of the area image sensor 1, a stereo range finder comprising area sensors 100 and 110 for head detection and head-air bag distance measurement is used. Therefore, a distance between a head of a passenger and an air bag can be detected in addition to a head elipse of the passenger. Accordingly, the configuration of the sensor for detecting both the head ellipse and the distance can be simplified.

(29) On page 13, please replace the paragraph beginning "In addition to" with the following amended paragraph:

In addition to the ~~above-mentioned~~stereo range finder in the modified embodiment 10, another area sensor may be ~~provides~~provided, thereby ~~enlarges~~ enlarging or reducing a picked-up image in accordance with a position of the passenger's head measured by the range finder.

(30) On page 17, in the Abstract, please replace the paragraph beginning "An object" with the following amended paragraph:

An object of the present invention is to determine a kind of a passenger, e.g., adult or child, without executing a complicated image processing, thereby controlling an unfolding of an air bag. The safety apparatus ~~against~~ for an automobile ~~clash~~ crash extracts a head ellipse from an image outputted from an area sensor. The apparatus stores beforehand reference head ellipses of every possible ~~kinds~~ kind of passenger's heads. The extracted head ellipse of the present passenger is selected among the references. Then, a region including the extracted head ellipse is designated to a future processing region for searching the same passenger's head at a time to come. Thus, the passenger's head is recognized simply and rapidly, even when the passenger has ~~once~~ moved outside the future processing region.